

The current state of the art and emerging technology

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INTRODUCTION

- The necessary exploration to decide the present status of the art and arising innovation in embedded systems technology, so that it can be considered in our project proposal.
- Software and hardware components are discussed in this file.

A BRIEF ABOUT OUR PROJECT

The device has sensors to detect the water level, humidity, and temperature, and all these parameters can be controlled by the particular plant's requirement. Grow lights will be used to give artificial sunlight to the plants. We will have a log of data of the different varieties of plant species and their requirements stored in the memory. All the data and controls can be accessed on a handheld device wirelessly over Bluetooth. We also will have a camera to monitor the Plant's health.

Image Processing is embedded in the main system since the camera will pick up any weird spots and color changes on the leaves of the plants, then analyze them with a library then notify the user.

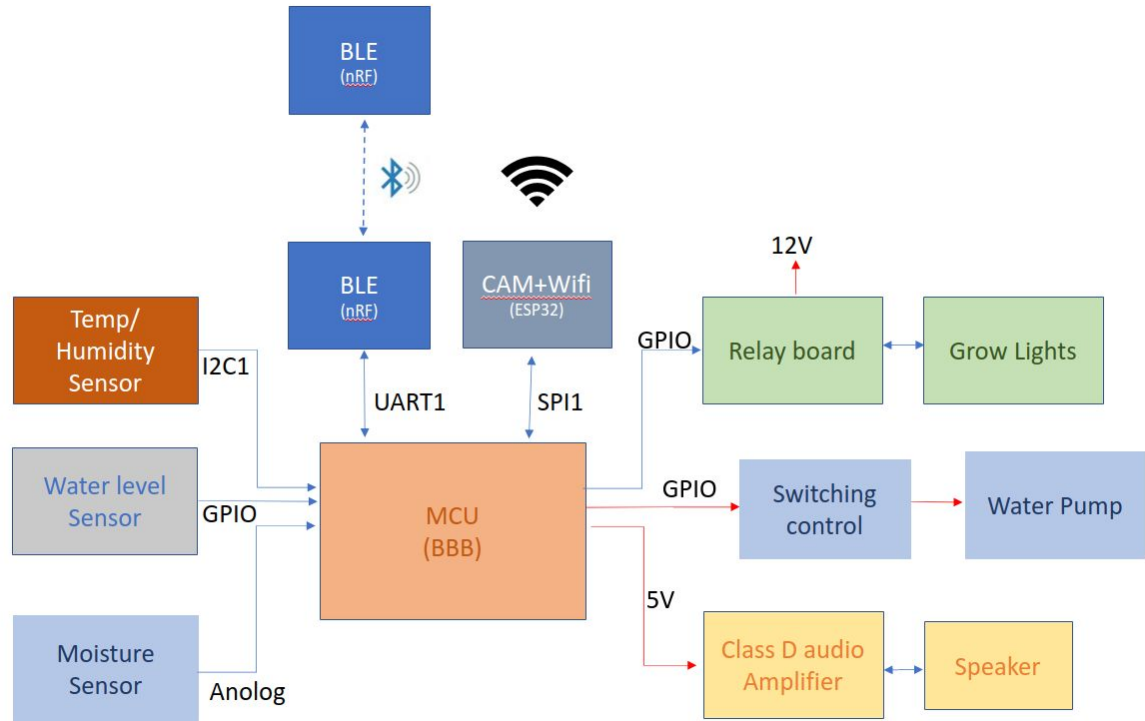
HARDWARE DESCRIPTION

→ Hardware Components include

1. BeagleBone Black
2. BLE(BlueTooth Low Energy) module
3. Camera
4. Sensors for temperature, moisture and water level
5. Grow Lights
6. Water Pump
7. Speaker

HARDWARE BLOCK DIAGRAM

This block diagram gives an central idea of the hardware block diagram i.e communication protocols, power supply and hardware components of the project



HARDWARE BLOCK DIAGRAM (CONT.)

In this block Diagram, Temp/Humidity Sensor, Water level Sensor, and Moisture Sensor are Input modules connected to the MCU through I2C communication, BLE(Bluetooth module) is connected using UART communication and communication with camera and Wifi is using SPI2 communication. MCU will process the readings from Temp/Humidity Sensor, Water level Sensor, and Moisture Sensor and control the Water pump and Grow lights according to the preset parameters.

HARDWARE BLOCK DIAGRAM (CONT.)

BLE has two-way communication. So, it will get the reading of moisture, water level, temp, and get the override control of the water pump, Grow lights, and speaker. ESP32 has both the camera and Bluetooth connectivity the input of the camera will be used for image processing and also Wifi connectivity will enable the mobile connectivity to remote devices and gives them control of the water pump and grow lights to a mobile user.

COMPONENTS SELECTION

Description	Cost	Link
Peristaltic Liquid Pump with Silicone Tubing - 12V DC Power	24.95	https://www.adafruit.com/product/1150
Plastic Water Solenoid Valve - 12V - 1/2" Nominal	6.95	https://www.adafruit.com/product/997
TUBING PVC 8MM ID X 1 METER	2.18	https://www.digikey.ca/en/products/detail/adafruit-industries-llc/4545/11627733?s=N4IgjCBcoLQBxVAYvgMwIYBsDOBTANCAPZQDa4ArAEwIC6AvvYVWSACwUcgNA
HUMIDITY & TEMPERATURE SENSOR BR	11.56	https://www.digikey.ca/en/products/detail/sparkfun-electronics/SEN-13763/6023505
SOIL MOISTURE SENSOR	8.65	https://www.digikey.ca/en/products/detail/sparkfun-electronics/SEN-13322/5764506

COMPONENTS SELECTIONS (CONT.)

Ultrasonic sensor to detect Water level	5.74	https://www.digikey.ca/en/products/detail/sparkfun-electronics/SEN-15569/10384560
Ultra Flexible White LED Strip - 480 LED per meter - 1m long - - Cool White ~6000K	11.95	https://www.adafruit.com/product/4612
BEAGLEBONE BLK REV C AM3358BZCZ	59.74	https://www.digikey.ca/en/products/detail/beagleboard-by-seeed-studio/102110420/12719590
Adafruit Feather RP2040	11.95	https://www.adafruit.com/product/4884
Stereo Enclosed Speaker Set - 3W 4 Ohm	7.50	https://www.adafruit.com/product/1669
Class D Audio Amplifier	8.95	https://www.adafruit.com/product/987
Compact Switching Power Supply - Selectable Output 3-12VDC	14.95	https://www.adafruit.com/product/798
TOTAL COST:	175.07	

COMPONENTS SELECTION(CONT.)

- The components have been selected based on their compatibility in voltage, current, etc.
- Some of the components or tools will be considered to be added in further research.
- The price is estimated. It is necessary to have the idea price so we can have a clear budget in our project.

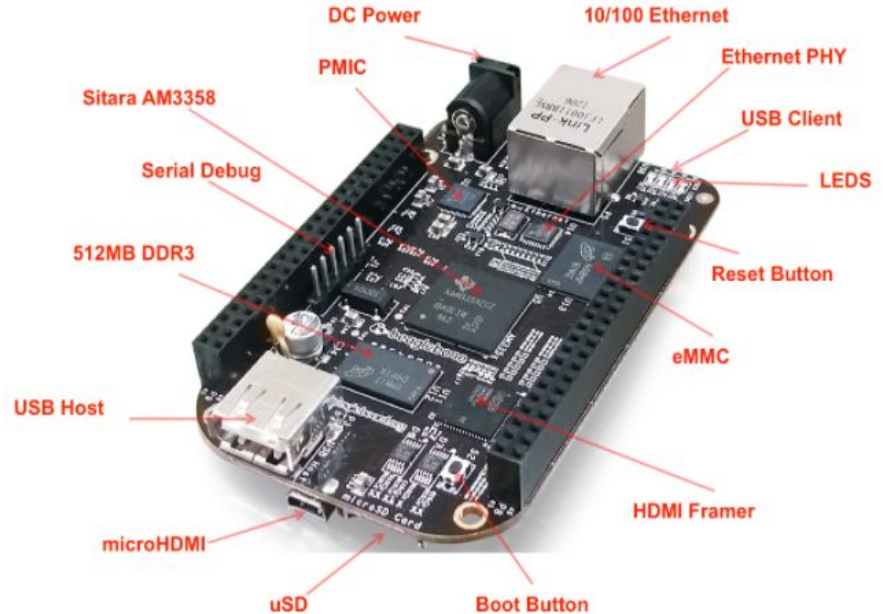
SOFTWARE DESCRIPTION

In this section we will explain about:

- OS, IDE selection
- Software block diagram - for libraries selection.

OPERATION SYSTEM

Our project will be built based on Debian- also known as GNU-Linux system, on Beaglebone Black



IDE SELECTION

Eclipse is an integrated development environment (IDE) used in computer programming. It contains a base workspace and an extensible plug-in system for customizing the environment.



SOFTWARE BLOCK DIAGRAM

The system will contains these functions and the necessary libraries:

All of the functions are using C++ language.

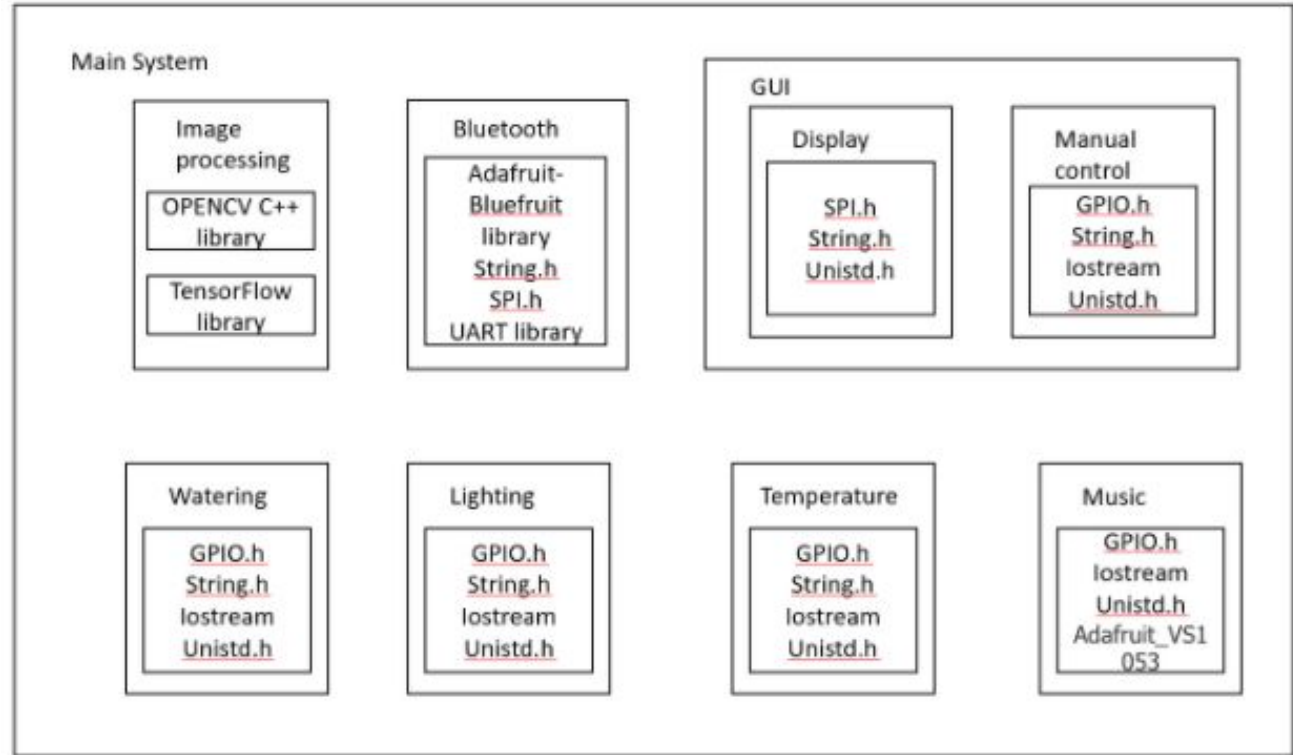
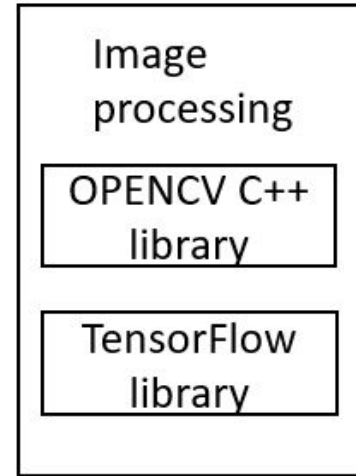


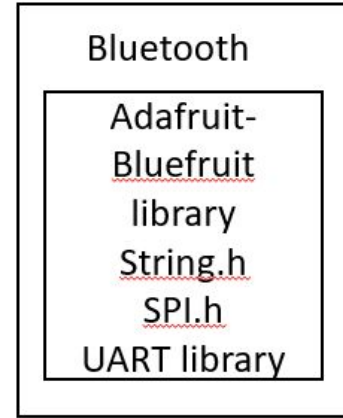
IMAGE PROCESSING

The first function is image processing, in this block camera-input would be used to compare to a database using Opencv(c++) to detect plant diseases and also allows to send images to a remote device such as a smartphone connected through Wifi.



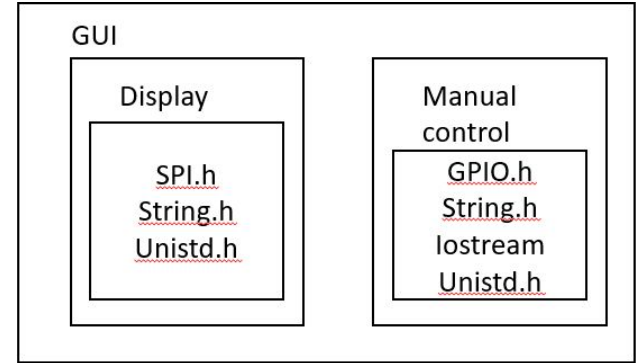
BLUETOOTH BLOCK

The second function is the Bluetooth function. This function will use the Adafruit Bluetooth module and it will use input from remote devices and its output will be used to control watering and lighting.



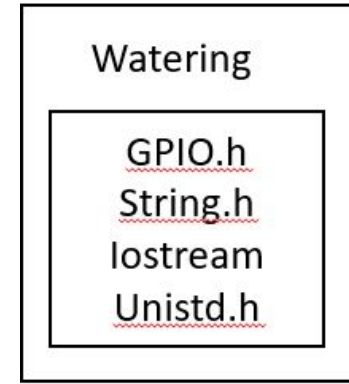
GUI (DISPLAY AND MANUAL CONTROL)

The third and fourth blocks come under GUI (GRAPHICAL USER INTERFACE). The display function will send the processed images to the smartphone through bluetooth connectivity and the manual control function will use the inputs from the smartphone to control watering, lightening, and speaker as output.



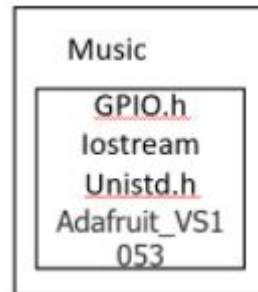
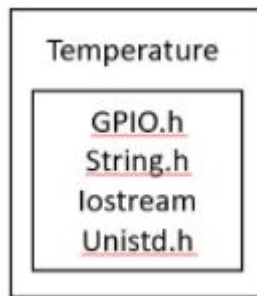
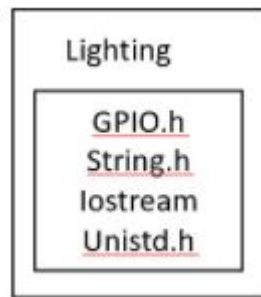
WATERING BLOCK

The watering function will use the inputs of BLE and ESP42 and sensors(Temp/Humidity sensor, Water level Sensor and Moisture Sensor) and its output will control the water pump.



LIGHTNING, TEMPERATURE AND MUSIC

The Lightning function will use the inputs of the temp sensor, BLE, and ESP32 and its output will control the Grow lights accordingly. The temperature function will use the input from the Temp/Humidity sensor and will control the lights as output. The music function will control the speaker based on ultra-Flexible. inputs from BLE and ESP32.



DESIGN TOOLS

In this project we can use Proteus Design Suite and Kicad to design the hardware, as well as running the simulation on software aspect.



PROTEUS

CONCLUSION

- In this project, we are thrive to achieve a perfect atmosphere for plants by responding to the change in physical parameters.
- Embedded systems is combined with hardware and software components.
- Hardware and software modules are discussed and explained with block diagrams.

THANK YOU

REFERENCES

<https://www.adafruit.com/product/1150>

<https://www.adafruit.com/product/997>

<https://www.digikey.ca/en/products/detail/adafruit-industries-llc/4545/11627733?s=N4IgjCBcoLQBxVAYygMwIYBsDOBTANCAPZQDa4ArAEwIC6AvvYVWSACwUcgNA>

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